8.—Notes on the Fabric of Some Charnockitic Rocks from Central Australia

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An exploratory study shows that in some charnockitic granulites the quartz fabric gives reasonable confirmation of the field evidence that the observed lineation is in the axial direction of folds. In others the quartz fabric has triclinic symmetry, suggesting some over-printing of the quartz fabric by later earth movements. In such rocks, however, other minerals such as hornblende, scapolite and possibly hypersthene are more reliable indicators of the direction of fold axes. In a major flat-lying plastic shear zone on which transcurrent movement is postulated, a prominent quartz girdle is developed about the strong lineation which plunges down the dip of the shear zone. The lineation is thought to be in *b* not *a*.

Introduction

While investigating the extensive area of charnockitic rocks in Central Australia, petrofabric studies were made of some of the rocks. This was done to try to confirm the field evidence that most of the observed lineations are approximately parallel to fold axes. This is a problem, because, in this little-known area, there is conflicting evidence of the relation between the prominent E.-W. trending ranges and the widespread N.-S. trend of the fold axes and lineation (shown by mineral elongation) in large areas within these ranges.

The charnockitic rocks from Central Australia have been described in several papers (for latest-review, see Wilson 1959). The following is a brief summary of the main features. The oldest rocks are charnockitic granulites, many of which are of sedimentary origin. Although some of the acid rocks are khondalitic, the bulk of the gneisses are adamellitic or granodioritic in composition, and probably represent both original greywackes and primitive igneous rocks, all of which have been subject to deep-seated regional metamorphism.

Interfoliated with these rocks are contorted bands and boudins of basic charnockites. Some of these probably represent original basic intrusions, but for others a sedimentary origin is probable. Owing to the plastic deformation which the host rocks have undergone in most areas, some of the basic bands were probably discordant dykes which have been drawn into conformity during metamorphism. Some of the basic charnockites have been converted into intermediate and acid charnockitic rocks by granitization and other metasomatic changes.

From Fig. 1 it will be seen that the foliation of the basement rocks is roughly meridional for at about 150 miles across the strike, i.e., throughout the central and eastern Musgrave Ranges. In many places the gneisses have been thrown into folds, many of which are tight, and all of which are ornamented with minor folds. Although the trend of the fold axes, and of a lineation are approximately meridional, there is the complication of gentle cross-folding or warping on E.-W. lines.

In the Ayers Ranges (particularly in the eastern half) the gneisses are folded on approximately meridional axes, and the lineation is essentially parallel to fold axes where these are known. In the Kulgera Hills the tectonic trend (as shown by tight fold axes and lineation and average strike-trends) is between 330° and 340°.

The basement rocks of the Musgrave Ranges are mostly of granulite facies, but many of those of the eastern portion of the Ayers Ranges, and all of those of the Kulgera Hills, are typical of high levels of the amphibolite facies.

In the Musgrave Ranges the whole complex of charnockitic granulites (and later gabbroic intrusions and anorthosites) is cut by large masses of charnockitic ferrohypersthene adamellite and granodiorite which have moved (probably as rheomorphic crystal mushes) into their present position.

In the Ayers Ranges and Kulgera Hills, hornblende granites and sphene-bearing granites, closely related to the charnockitic intrusions of the Musgrave Ranges, have been emplaced into basement rocks which in those areas are largely of upper amphibolite facies.

Extensive field work must precede the explanation of the apparent contradiction of the long E.-W. string of petrologically closely-related magmatic granites, many of which form N.-S. bodies sub-parallel to the linear structures and major fold structures of the basement rocks. It it tentatively suggested, however, that a regional deep-seated E.-W. downwarp (possibly associated with deep-seated E.-W. transcurrent shearing) may have been sufficient to have caused thorough reconstitution of the basement rocks, and to have produced "pockets" of potential magma in favourable areas. Subsequent emplacement of the resultant rheomorphic masses would be assisted by pre-existing weaknesses due to the N.-S. attitude of many of the original rocks.

Notwithstanding the obvious structural complications, it was decided to make a preliminary study of some quartz fabrics in the first instance. This was done, moreover, despite the

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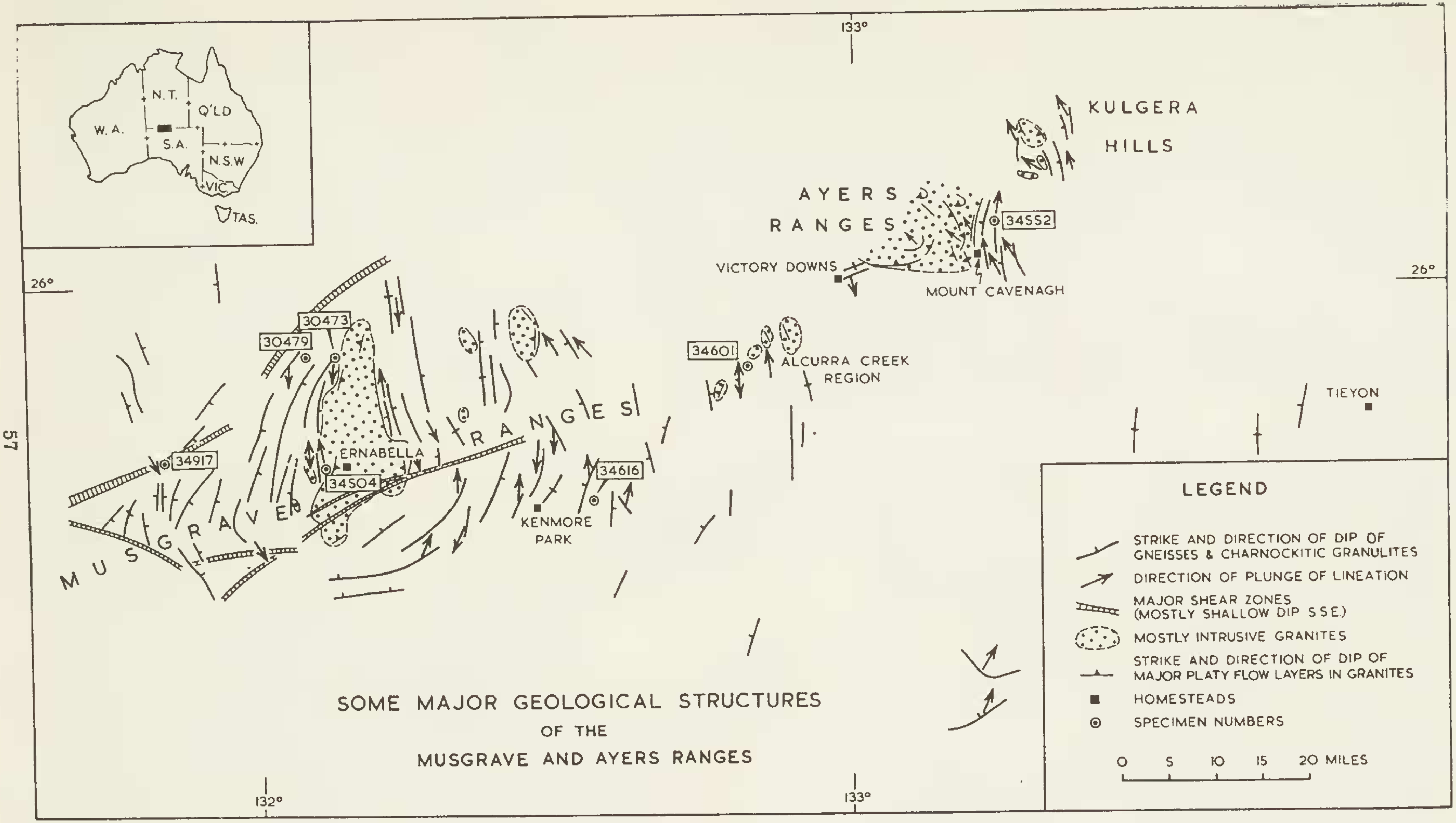
SOME MAJOR GEOLOGICAL STRUCTURES
OF THE
MUSGRAVE AND AYERS RANGES
LEGEND
STRIKE AND DIRECTION OF DIP OF GNEISSES & CHARNOCKITIC GRANULITES
DIRECTION OF PLUNGE OF LINEATION
MAJOR SHEAR ZONES (MOSTLY SHALLOW DIP S.S.E.)
MOSTLY INTRUSIVE GRANITES
STRIKE AND DIRECTION OF DIP OF MAJOR PLATY FLOW LAYERS IN GRANITES
HOMESTEADS
SPECIMEN NUMBERS
0 5 10 15 20 MILES
KULGERA HILLS
AYERS RANGES
VICTORY DOWNS
MOUNT CAVENAGH
34552
34601
ALCURRA CREEK REGION
TIEYON
MUSGRAVE RANGES
30473
30479
34917
ERNABELLA
34504
34616
KENMORE PARK
W.A.
N.T.
Q'LD
S.A.
N.S.W
VIC.
TAS.
26°
133°
132°

Fig. 1

fact that Sahama had found difficulty in interpreting many unusual quartz fabrics from the granulites of Lapland (Sahama 1936). Difficulties were soon encountered, for quartzites are absent, mica is rare, and there are no marbles to assist in correlation of fabric results. Hence, measurements had to be made on rocks of various types, some of which contain only a small percentage of quartz. Moreover, only a few suitably oriented specimens are available. The reason for this is that several important areas were mapped as early as 1943 when I did not fully appreciate the need for oriented specimens. Thus, the present study is merely exploratory. Certain results, however, are useful, and may guide future workers in this field.

Fabric Analysis

The following are some notes on the fabric of several rocks.

Specimen No. 34504†.—This rock, a medium-grained poorly banded hypersthene-microperthite-andesine-quartz granulite, is typical of the acid charnockitic granulites of the Musgrave Ranges (Fig. 1). It crops out one-quarter mile ESE. of Harris Springs near Ernabella. The strike is 175°, dip 85° W.; the lineation plunges 20° due S. and is parallel to the axes of minor and major folds, most of which are nearly isoclinal in this area.

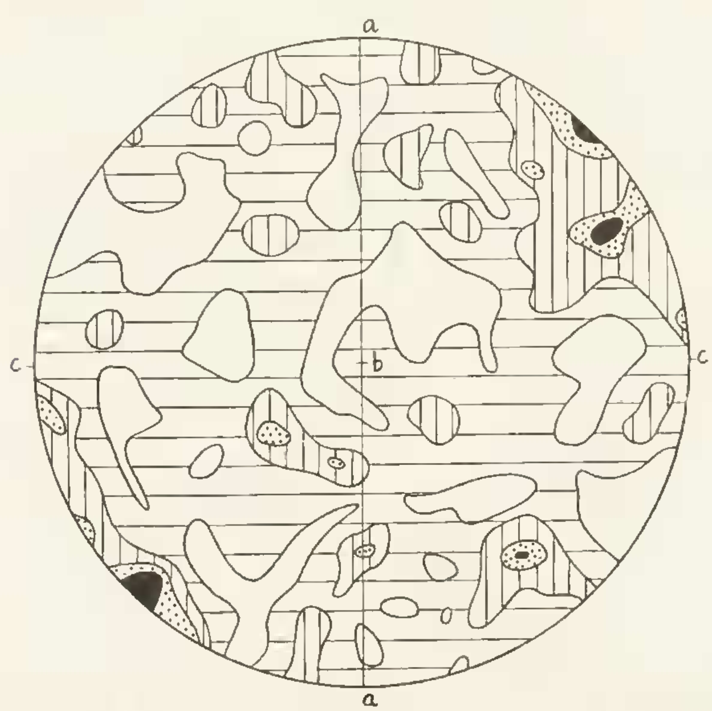

Fig. 2.—*Acid charnockitic granulite* (34504) near Ernabella, Musgrave Ranges. Orientation diagram of 300 *quartz* optic axes in section normal to lineation which plunges 20° due S. Banding in granulite (shown by line *ab*) has strike 175° and dip 85° W.

Orientation: Looking N. along lineation *(b)* with top of diagram the approximate top of specimen.

Contours: 0, 2, 3, 4, (including 5% maximum).

Fig. 2 shows the orientation of 300 quartz optic axes in a section cut normal to the lineation. There is a weak *ac*‡ girdle with a maximum about midway between *a* and *c* in quadrants one and three. The presence of a submaximum within quadrant three suggests that an incomplete girdle may also pass through *b* thus linking the main maxima in quadrants one and three. However, the concentrations away from the edge of the diagram may be due to overprinting of an original fabric. If significance is to be placed on these, the symmetry of the fabric would fall from monoclinic to triclinic.

Hornblende is absent and biotite very rare, but hypersthene has a tendency to be flattened in the *ab* plane. In an interbedded rock a few biotite flakes are found, and these have cleavage planes parallel to *ab*. In other associated rocks hornblende is well alined with its *c* crystallographic axis parallel to the lineation, and its *b* crystallographic axis more or less parallel to *a*. Notwithstanding some possible overprinting of the quartz fabric, the total fabric of this rock would seem to confirm the field evidence that the lineation is parallel to the fold axis.

Specimen No. 30473.—This rock is a medium-grained banded hypersthene-microperthite-quartz-andesine granulite, and is typical of the extreme NE. tip of the range to the N. of Alalka, and crops out about three miles E. of Wardulka rock-hole. The strike is 50°, dip 30° SE. and there is a fair lineation plunging 10°-15° in a direction 185°. Reference to the map (Fig. 1) shows that the rock occurs near the nose of a major syncline (plunging flatly S.), and its lineation is in the axial direction of that fold. 34504 (described above) is taken from a position on the W. flank of the same structure.

The specimen was collected during my 1943-1944 expedition to the area and is not orientated. However, a section was cut approxi-

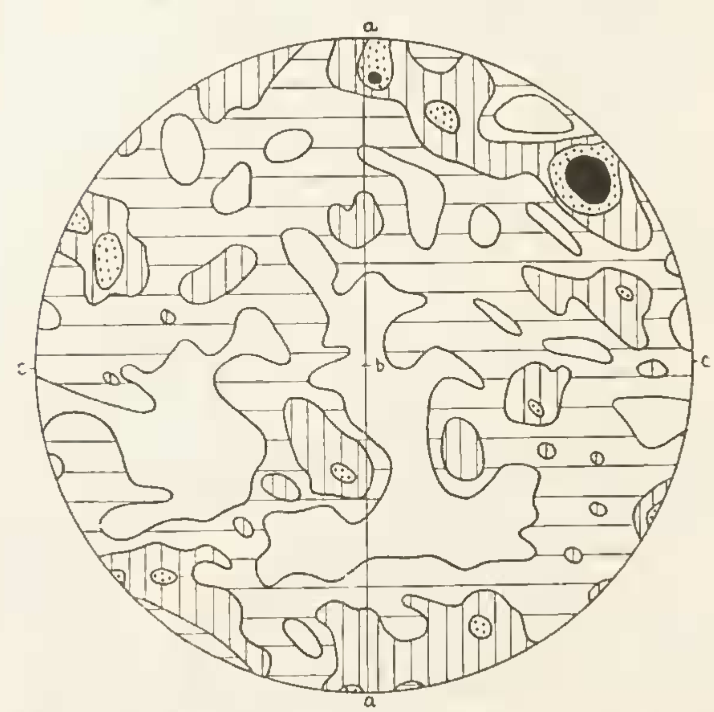

Fig. 3.—*Acid charnockitic granulite* (30473) ESE. of Wardulka, Musgrave Ranges. Orientation diagram of 300 *quartz* optic axes in section normal to lineation *(b)* which plunges 10° to 15° in direction 185°. Banding in granulite (shown by line *ab*) has strike 50° and dip 30° SE. Non-oriented specimen.

Contours: 0, 2, 3, 4 (including 5% maximum).

† All numbers refer to specimens in the rock collection of the University of Western Australia.

‡ Sander's original terminology is used in this paper (as in Cloos 1946, p. 6): *b* is fold axis, *a* is perpendicular to *b* in the movement plane, and *c* is perpendicular to *ab*.

mately normal to the lineation as seen in the hand-specimen, and the orientation of 300 optic axes of quartz was measured (see Fig. 3). As in 34504, there is a weak *ac* girdle with a maximum between *a* and c. Minor concentrations recall those seen in 34504.

A preferred orientation of plagioclase (with 001 ⊥ lineation) was suspected, but not measured. Biotite is absent, and the small amount of hypersthene (3%) shows no obvious preferred orientation. Strictly speaking, the fabric has triclinic symmetry, possibly due to overprinting of the quartz fabric, but it is close to monoclinic symmetry, and thus tends to confirm that the lineation is parallel to the fold axis.

Specimen No. 30479.—This rock, a medium-grained banded hypersthene-hornblende-microperthite-quartz-andesine granulite of granodioritic composition, is well exposed at the Wardulka rock-hole. It is a partly granitized relic of a basic band set in an otherwise fairly homogeneous adamellitic pyroxene granulite (like 30473). The strike is 20°-30°, dip 40° S. and there is a fairly good lineation plunging about 5° in a direction 185°. Reference to the map (Fig. 1) shows that the lineation is in the axial direction of the same major S.-plunging syncline to which both 34504 and 30473 are referable. Axes of nearby tight drag folds (two to three feet from crest to trough) plunge at low angles almost due S. The specimen was collected during the 1948-1949 expedition and unfortunately is not orientated. However, a section was cut normal to the well lineated hornblende crystals, and 300 optic axes of quartz were measured (see Fig. 4).

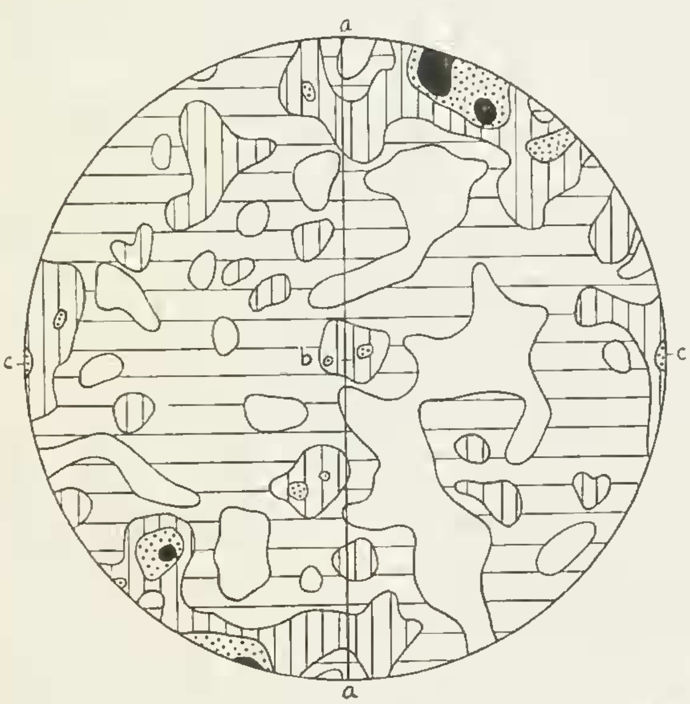

Fig. 4.—*Acid charnockitic granulite* (30479), Wardulka, Musgrave Ranges. Orientation diagram of 300 *quartz* optic axes in section normal to lineation *(b)* which plunges about 5° in direction 185°. Banding in the granulite (shown by line *ab)* has strike 20° to 30° and dip 40° S. Non-oriented specimen.
Contours 0, 2, 3, 3½ (including 4% maximum).

In this rock, although the quartz shows a poor girdle about *b*, the symmetry of the diagram is triclinic. The minor concentrations near the centre and within quadrant three (as here orientated) even suggest a partial girdle through *b* and oblique to *ab*. There is also a submaximum appearing at c. The hornblende is well orientated with the crystallographic c axis parallel to the *b* lineation, and the crystallographic *b* axis parallel to the *a* fabric axis. Mimetic growth of reaction-quartz as granules intimately associated with the hornblende crystals could account for the small but significant concentration of quartz optic axes at *b*.

Specimen No. 34552.—This rock, which is typical of the gneisses of the Ayers Ranges, is a biotite-bearing granitic gneiss in which a few granules of hypersthene remain to indicate its affinity with the charnockitic granulites of the Musgrave Ranges to the W. It occurs (3¾ miles NNE. of Mt. Cavenagh Homestead) on the E. limb of a syncline in a series of folds which plunge 45° in a direction 10° (see Fig. 1). The well-developed lineation is clearly parallel to the axes of the folds.

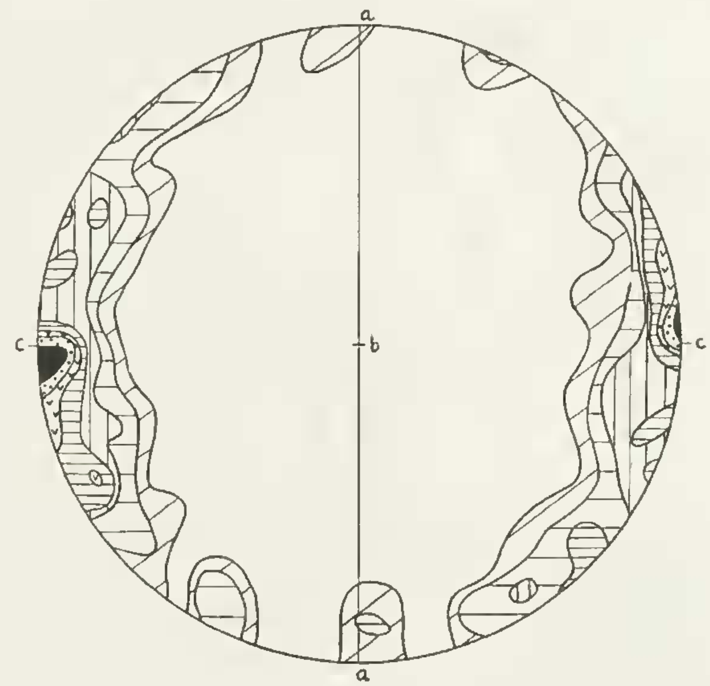

Fig. 5.—*Biotite-bearing acid charnockitic gneiss* (34552) near Mt. Cavenagh Homestead, Ayers Ranges, Central Australia. Orientation diagram of 100 cleavage poles of *biotite*. Orientation as for Fig. 6.
Contours: 0, 2, 4, 6, 8, 10, 12 (including 14% maximum).

A microfabric study of 100 cleavage poles of biotite (Fig. 5) confirms the foliation (= bedding) is the *ab* plane which strikes 40° and dips 50° N.W. A plot of 300 quartz optic axes, however, demonstrates clearly that there has been some overprinting of the quartz fabric (Fig. 6). The maxima do not fall in the *ac* plane, nor on any single great circle. Without a study of other rocks from the area it is impossible to say which maxima (if any) are original and which are due to superimposed forces.

Large granite intrusions have been emplaced nearby. Linear flow-lines and general attitude of well-developed platy flow-layers indicate that important stresses must have acted on the area from a direction probably 45° away from those which controlled the formation of the original folding and lineation in the fold axis direction. The stresses associated with the emplacement of the granite presumably were able to modify the quartz fabric without appreciably affecting the orientation of biotite or the macroscopic lineation in *b*. This confirms the long-recognized fickle behaviour of quartz in metamorphic rocks, and demonstrates the need for caution in the use of quartz diagrams where superimposed earth movements are suspected. A corollary of considerable practical importance, however, is that a macroscopic lineation (originally in the fold axis direction) may be expected to survive superimposed stresses of moderate rigor, and, with caution, may be used to decipher the folding of the lineated rocks.

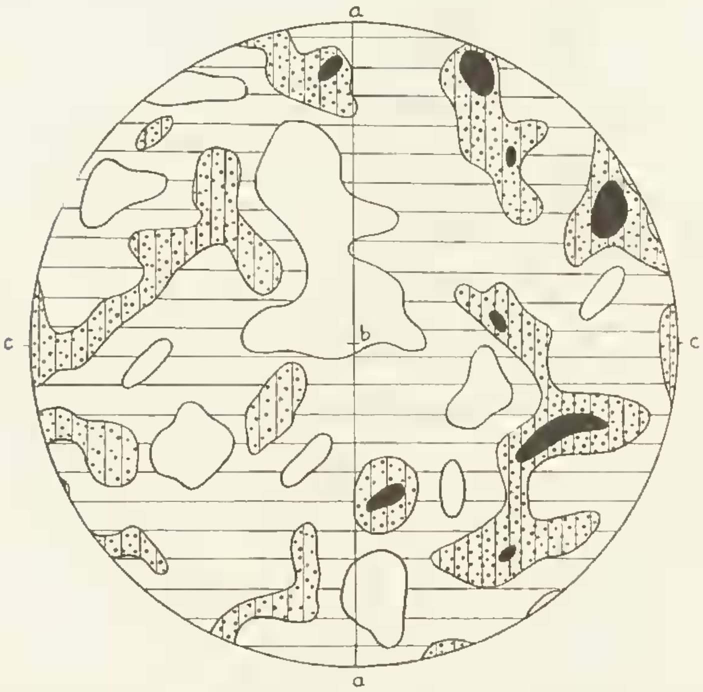

Fig. 6.—*Biotite-bearing acid charnockitic gneiss* (34552) near Mt. Cavenagh Homestead, Ayers Ranges, Central Australia. Orientation diagram of 300 *quartz* optic axes in section normal to lineation which plunges 45° in a direction 5°. Foliation (shown by line *ab*) has strike 40° and dip 50° NW. Orientation: Looking approximately N. along lineation (*b*) with horizontal line on specimen approximately tangent to the 2nd quadrant.
Contours: 0, 2, 3 (including 3½% maximum).

Specimen No. 34601.—This rock is a cordierite-sillimanite-bearing granitic gneiss which lies between the Ayers Ranges (e.g. 34552) and the Musgrave Ranges. It crops out 14 miles WSW. of Victory Downs Homestead, and two miles WSW. of the Alcurra Creek Crossing on the track to the Musgrave Ranges. The strike is 354°, dip 70°-80° E., and a good lineation (shown by small sillimanite needles) plunges 2°-3° toward 354°. This lineation, which is parallel to the axes of several small folds, is meridional in trend and comparable with that observed in most parts of the Ayers Ranges to the E., and in the Musgrave Ranges to the W.

Figure 7 shows the orientation of 300 quartz optic axes. Although there is a weak girdle about *b* there is no symmetry about the *ab* plane. If *a* be moved about 20° into quadrant one to a^1, the quartz maxima display approximate symmetry about the a^1b plane. Unfortunately, there is insufficient biotite in this rock to

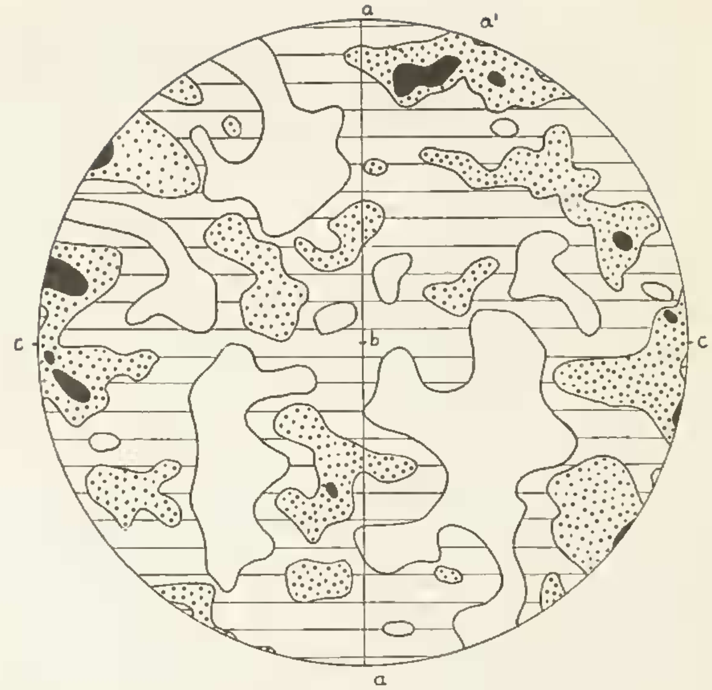

Fig. 7.—*Acid cordierite-sillimanite gneiss* (34601), Alcurra Creek region between Musgrave and Ayers Ranges, Central Australia. Orientation diagram of 300 *quartz* optic axes in section normal to lineation (*b*) which plunges 2° to 3° in direction 354°. Foliation (shown by line *ab*) has strike 354° and dip 70° to 80° E. Orientation: Looking N. along lineation with top of diagram the approximate top of specimen.
Contours: 0, 2, 3 (including 4% maximum).

see whether the *ab* plane could be fixed more accurately than by the foliation trace. Since lineation is made macroscopically visible mainly by the elongation of sillimanite needles, and since it can be shown that the quartz crystallized much later than the sillimanite, it is possible that the quartz maxima were developed during a late stage of the same orogeny when the stress directions were somewhat modified.

Since this rock lies close to a large intrusive granite, stresses sufficient to partly overprint the quartz fabric but not to re-orientate the sillimanite needles are almost certain to have been in action. It will be recalled that similar interference was postulated for 34552 from the Ayers Ranges.

Notwithstanding the possible effect of the granite, the field evidence is clear that the lineation as shown by the sillimanite needles is still parallel to an original fold axis. Obviously, however, more than one orientated rock is needed to elucidate the quartz fabric of the gneisses of the area.

Specimen No. 34616.—This rock is a scapolite-bearing basic charnockite collected from good outcrops 200 yards E. of No. 7 Well, about seven miles E. of Kenmore Park Cattle Station in the eastern Musgrave Ranges. Basic and intermediate granulites are common in the vicinity, and, as with the interbedded enderbites, they have a good lineation with a flat plunge due N. The rocks have been folded on meridionally-trending axes, and the lineation is consistently parallel to the fold axes. The strike of 34616 is 19°, dip 35° W., and lineation plunges 3°-5° in a direction 2°.

1

2

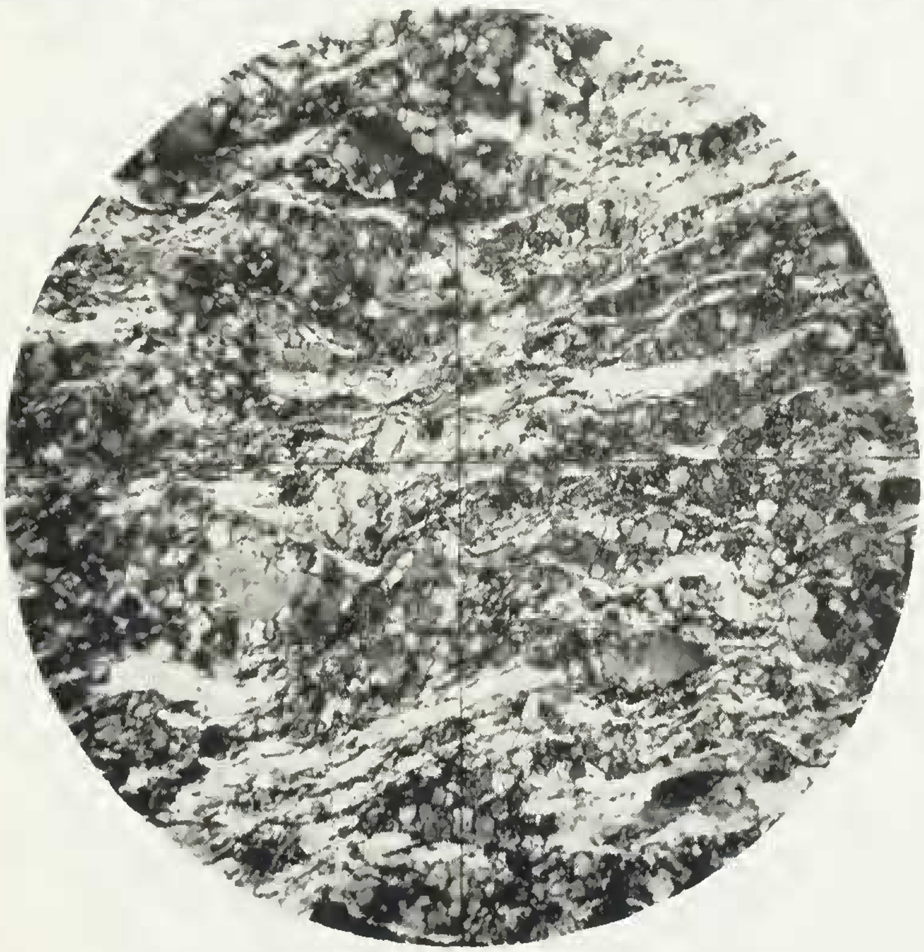

PLATE I

1.—Lineation (parallel to small hammer handle) on mylonitized rocks in the Woodroffe Shear zone as exposed in Brown's Pass, Musgrave Ranges (see locality of specimen 34917). Strike 238° (parallel to large hammer handle), dip 8° to 10° SE. with strong lineation plunging 8° to 10° in direction 140°. Looking approximately W.

2.—Shredded masses of quartz (white) more or less in optical continuity over considerable areas. A few rounded relics of feldspar (dark grey) are present. Note the s-shaped swirls (especially, quadrant 4) which suggest that in this sheared rock the direction of movement was normal (not parallel) to the direction of lineation. Section normal to lineation in *mylonitized granitic gneiss* (34917). Brown's Pass, Musgrave Ranges. Crossed nicols, x25.

An attempt was made to measure the orientation of quartz in certain contorted leucocratic schlieren in the basic rock. Only 200 grains could be measured, and the fabric diagram appears as Fig. 8. No symmetry is revealed in this diagram, and the only important maximum seems to lie off the periphery and some 20° from *a*.

Fig. 8.—*Scapolite-bearing basic charnockite* (34616) from 7 miles E. of Kenmore Park Homestead, Musgrave Ranges. Orientation diagram of 200 *quartz* optic axes in section normal to lineation *(b)* which plunges 3° to 5° in a direction 2°. Banding (shown by line *ab*) has strike 19° and dip 35° W.
Orientation: Looking N. along lineation with horizontal line of specimen approximately tangent to 2nd quadrant.
Contours: 0, 2, 3 (including 4% maximum).

The hornblende of this rock is well alined with its *c* axis parallel to the lineation and fold axes of the area. There is no obvious preferred orientation of the *b* crystallographic axis in the *ab* fabric plane such as was found in 30479.

Scapolite, a rare mineral in the charnockitic granulites of the Musgrave Ranges, comprises about 12 per cent of the basic portions of the rock. Petrographic evidence is that it formed at the same time as the pyroxenes and hornblende, and is thus not a secondary mineral. The orientation of the optic axes of 100 grains of scapolite was measured, and an incomplete girdle about *b* was found (Fig. 9). There is no symmetry about the *ab* plane and the maxima are all several degrees within the periphery. Little is known of the orientation of scapolite in deformed rocks—the only reference noted would indicate that the *c*-axis becomes oriented in the *ab* plane (Fairbairn 1949, p. 9).

It would appear, therefore, that in this rock quartz has failed to give confirmation of the field evidence that the lineation is in *b*. The hornblende and possibly scapolite are more reliable.

Specimen No. 34917.—A prominent zone of intense shearing extends for at least 40 miles ENE. from the N. face of Mt. Woodroffe.

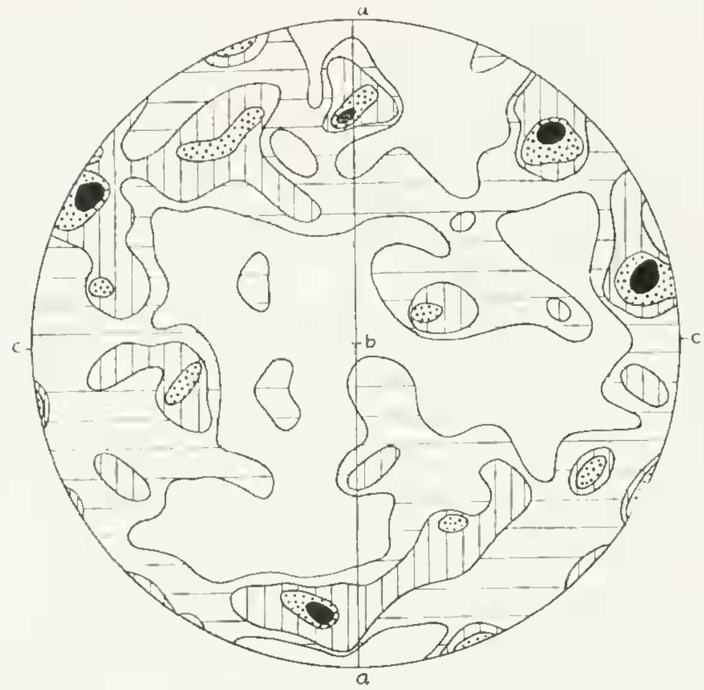

Fig. 9.—*Scapolite-bearing basic charnockite* (34616) from 7 miles E. of Kenmore Park Homestead, Musgrave Ranges. Orientation diagram of 100 *scapolite* optic axes in section normal to lineation *(b)*.
Orientation as in Fig. 8.
Contours: 0, 2, 3, 4 (including 5% maximum).

Gneisses and granulites of various kinds occur within this shallow-dipping zone which is upwards of one half-mile wide in outcrop. In places the rocks are intensely mylonitized, and dense chert-like rocks and pseudo-tachylytes are common. The plastic shearing did not necessarily take place at great depth, but the presence of tiny garnets (less than 0.05 mm.) indicates the development of considerable local heat. Thin-sections of any of the rocks from the zone are readily recognized by the extreme shadowy extinction and shredded nature of the quartz and feldspars and the common development of "shredded" biotite and tiny garnets instead of pyroxene and calcic plagioclase.

Figure 10 shows the orientation of 150 optic axes of quartz from a heavily sheared and well lineated granitic gneiss (34917). The rock occurs on the E. side of the N. mouth of Brown's Pass. Here the rocks have suffered considerable shearing and the resultant rock looks flaggy in the field (Plate 1, 1). The strike is about 238°, and dip is 8° to 10° SE., and there is a strong lineation plunging 8° to 10° in direction 140°. Figure 10 is statistically weak because large quartz grains have been shredded into 20 or more irregular pieces, many of which cannot be measured (Plate 1, 2). At least 1,000 grains would need to be measured before the position of quartz maxima could have much significance. Notwithstanding the poor statistical value of the diagram, it is clear that not only is there a marked girdle about the lineation, but it shows monoclinic or even orthorhombic symmetry. This girdle is much more pronounced than anything seen in the normal granulites of the area.

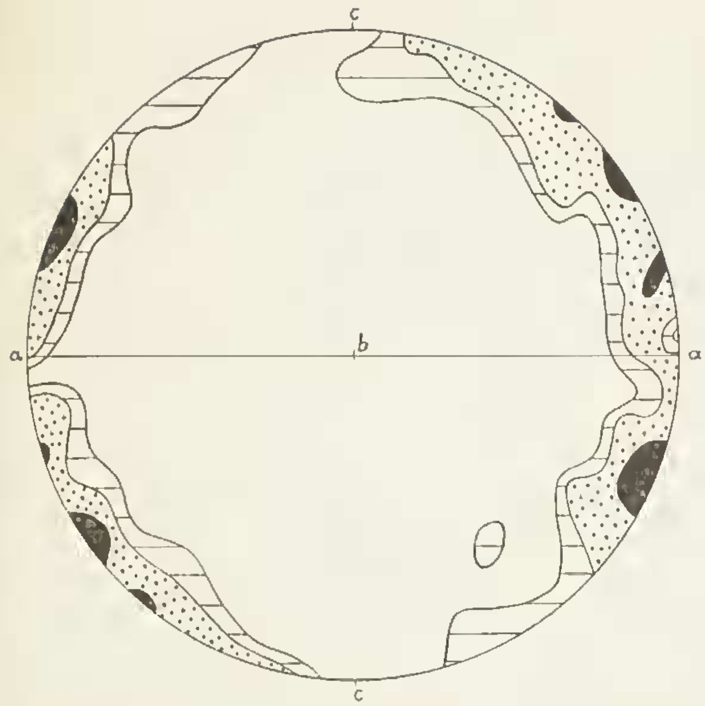

Fig. 10.—*Mylonitized granitic gneiss* (34917), Brown's Pass, Musgrave Ranges. Orientation diagram of 150 *quartz* optic axes in section normal to strong lineation *(b)* which plunges 8° to 10° in direction 140° (i.e., down-dip). Banding (shown by line *ab*) has strike 238° and dip 8° to 10° SE. Orientation: Looking N.W. along the lineation with top of diagram the approximate top of specimen.
Contours: 0, 3, 6 (including 9% maximum).

Indeed, the fabric diagram and field occurrence are such that some would interpret the structure as a thrust, and the lineation as an *a*-lineation. Thus, Kvale states that in a thrust zone, "where the main lineation is parallel to the principal direction of movement the diagrams have a perfect monoclinic symmetry, the plane of symmetry being perpendicular to the lineation . . . " (Kvale 1953, p. 59). Joklik has made similar observations on rocks from thrust zones in the Harts Range (Townley and Noakes, 1954, p. 151). Indeed, several authors maintain that there is evidence that lineation in *a* is typical of areas affected by "thrust tectonics," and that the more common lineation in *b* is more characteristic of areas affected by "fold tectonics."

This flat-lying shear zone in Central Australia has been called a thrust (namely, the Woodroffe Thrust). Since a prominent lineation is almost directly down-dip, it has been assumed that the direction of movement on the thrust was in the direction of the lineation, that is, S. block up and N., with little strike-slip component. I once held this view myself, beguiled (as I fear others have been) by the assumption that flat-lying faults must be thrusts, and that lineation on rocks in a fault zone is always in the direction of movement on the fault. If one argues in circles in this way it is easy to "prove" that lineation on a fault is an *a*-lineation.

In the rock under discussion, s-shaped swirls are evident in thin-sections cut normal to the lineation (Plate 1, 2). Thus, the direction of movement is normal (not parallel) to the direction of lineation.

It is my belief that the effects of the deformation which has produced the mylonitized rock under discussion were not restricted to the mylonitized zone. Indeed, it is likely that this zone is merely a zone where the tectonic forces have become more concentrated, thus causing the gneisses to flow more readily in a "plastic" manner. As stresses are built up, open folds become isoclinal folds, and in some places more so than in others a rigid banding develops. Even though the limbs and eventually the thickened crests and troughs of folds become "smeared out," it would appear that if the process takes place at a high level of metamorphism (such as amphibolite or granulite facies) the lineation in these finely granulated, very regularly banded rocks will still represent the direction normal to the direction of dominant movement in the rock mass under deformation.

My present view is that the term "Woodroffe Thrust" should be replaced by "Woodroffe Shear-zone." The movement on this structure has been largely transcurrent (i.e., strike-slip). Indeed, deep-seated plastic shearing of this type may have taken place along a number of sub-parallel zones in the Musgrave Ranges. The strong couple developed between such zones may have been a major factor in producing in the gneisses and granulites many of the folds whose axes trend at a steep angle to the trend of the postulated transcurrent plastic shear zones.

The regional significance of the several great shear zones known in the Musgrave Ranges can scarcely be further discussed with profit while our knowledge of the fold patterns, and distribution of major igneous bodies and later basic dyke swarms of the area is so limited.

Conclusions

Preliminary work on several charnockitic granulites from Central Australia shows that in some rocks (e.g. 34504) the symmetry of quartz fabric is close to monoclinic, and thus gives reasonable confirmation of the field evidence that the observed lineation is parallel to fold axes (see Turner 1957). In others, however, the quartz fabric has triclinic symmetry, thus indicating some overprinting of the quartz fabric by later earth movements.

In rocks where the quartz has failed to give confirmation of the field evidence that the lineation is in the axial direction of the folds, other minerals such as hornblende, scapolite, sillimanite and possibly hypersthene have proved more reliable. Enough work has been done in this area to show that lineation (i.e., that developed from mineral elongation) in the normal gneisses and granulites is worthy of careful field record and use.

In a major flat-lying plastic shear zone (the Woodroffe Shear-zone) there is a strong lineation, and a fabric analysis shows that a very prominent quartz girdle of monoclinic (close to orthorhombic) symmetry has developed about the lineation which plunges in the dip direction. The lineation is thought to be in *b* not *a*, and the shear-zone is thought to represent a major transcurrent movement of considerable tectonic significance.

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